

# Erasmus Talk

## Facultatea de Fizică



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# Solar Cell Technologies Across Four Generations: Progress, Challenges, and Emerging Trends

## Abstract

The evolution of solar cell technology reflects a remarkable evolution of scientific innovation and engineering refinement aimed at improving efficiency, reducing cost, and expanding application domains. This conference presentation provides a comprehensive overview of photovoltaic (PV) technologies from first-generation to emerging fourth-generation solar cells, highlighting the key materials, device architectures, performance milestones, and future prospects.

First-generation solar cells, primarily based on crystalline silicon wafers, established the commercial foundation of the photovoltaic industry through high efficiency and long-term stability. Second-generation technologies introduced thin-film materials such as amorphous silicon, CdTe, and CIGS, significantly reducing material consumption and manufacturing costs while enabling flexible applications. Third-generation solar cells expanded the frontier through advanced concepts including dye-sensitized, organic, quantum dot, and multi-junction devices, focusing on surpassing traditional efficiency limits and enabling lightweight, semi-transparent, and portable solutions. Finally, fourth-generation solar cells integrate nanomaterials, hybrid organic–inorganic structures, and perovskite-based architectures, combining high efficiency with low-temperature processing and enhanced versatility for next-generation energy systems.

The presentation will examine technological breakthroughs, efficiency trends, manufacturing challenges, sustainability considerations, and commercialization pathways across generations. By outlining both the scientific progress and remaining barriers, this talk aims to provide a clear perspective on how photovoltaic technologies are transitioning from conventional silicon dominance toward highly engineered, multifunctional energy-harvesting platforms that will shape the future of renewable energy.

<https://sites.google.com/view/mihaelagirtan>

## Detalii eveniment:

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